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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/770,045	02/02/2004	Richard A. Blanchard	GS 159 D1	9504
27774	7590	04/07/2005	EXAMINER	
MAYER, FORTKORT & WILLIAMS, PC 251 NORTH AVENUE WEST 2ND FLOOR WESTFIELD, NJ 07090			MAI, ANH D	
			ART UNIT	PAPER NUMBER
			2814	

DATE MAILED: 04/07/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/770,045

Applicant(s)

BLANCHARD, RICHARD A.

Examiner

Anh D. Mai

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 02 February 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 27-44 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 27-44 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 2/2/2004; 5/10/2004.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Status of the Claims*

1. The Preliminary Amendment filed February 02, 2004 has been entered. Claims 1-26 have been cancelled. Claims 27-29 have been amended. Claims 27-44 are pending.

### *Specification*

2. A status update of the co-pending application is requested.
3. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested:

POWER SEMICONDUCTOR DEVICE HAVING A VOLTAGE SUSTAINING  
REGION THAT INCLUDES TERRACED TRENCH WITH CONTINUOUS DOPED  
COLUMNS FORMED IN AN EPITAXIAL LAYER.

### *Claim Rejections - 35 USC § 112*

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 38 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 38 depends on claim 37 and recites: said dielectric material is **silicon nitride**.

However, the dielectric material of claim 37 is silicon dioxide.

Thus, claim 38 is indefinite.

Therefore, the merit of claim 38 can not be determined.

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 27-35 and 39-43 are rejected under 35 U.S.C. 102(e) as being anticipated by Deboy et al. (U.S. Pat. No. 6,649,459) of record.

With respect to claim 27, insofar as the device is concerned, Deboy teaches a power semiconductor device as claimed including:

a substrate (1) of a first conductivity type;

an epitaxial layer (4) having a first or second conductivity type formed on the substrate (1);

a voltage sustaining region (5) of a conductivity type opposite to the conductivity type of the epitaxial formed in the epitaxial layer, wherein the voltage sustaining region comprising a terraced trench having a trench bottom and plurality of portions that differ in width to defined at least one annular ledge therebetween; (See Fig. 4d);

a filler material (5) substantially filling the terraced trench;

at least one region (6) of conductivity type opposite to the conductivity type of the epitaxial layer formed over the voltage sustaining region (5) to define a junction therebetween.  
(See Figs. 4 and 16)

Product by process limitation:

The expression “A power semiconductor device made in accordance with the method comprising the step of.....” is/are taken to be a product by process limitation and is given no patentable weight. A product by process claim directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

**Note that Applicant has burden of proof in such cases** as the above case law makes clear.

With respect to claim 28, insofar as the device is concerned, Deboy teaches that “if appropriate, these step can be carried out repeatedly with side wall coverage and deepening of

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the trench”, the claimed at least three portions that differ width from one another is anticipated by Deboy.

With respect to claim 29, the device of Deboy further includes:

a gate conductor (8) formed above a gate dielectric region;

a first and second body regions (6) formed in the epitaxial layer to define a drift region therebetween, the body regions (6) having a conductivity type (p) opposite to the conductivity type of the epitaxial layer (N); and

a first and second source regions (7) of the first conductivity type in the first and second body regions (6), respectively. (See Fig. 16).

With respect to claim 30, Deboy teaches a power semiconductor device as claimed including:

a substrate (1) of a first conductivity type;

a voltage sustaining region (5) disposed on said substrate (1), the voltage sustaining region includes:

an epitaxial layer (4) having a first or second conductivity type;

at least one terraced trench (17) located in the epitaxial layer, the terraced trench having a trench bottom and a plurality of portions that differ in width to define at least one annular ledge therebetween;

at least one doped column (5) having a dopant of a conductivity type opposite to the conductivity type of the epitaxial layer, the doped column being formed from at least one annular doped region and another doped region diffused into one another (continuously doped), the at

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least one annular region and the another doped region being located in the epitaxial layer adjacent to and below the at least one annular ledge and the trench bottom, respectively;

a filler material (5) substantially filling the terraced trench; and

at least one active region (6) of a conductivity opposite to the conductivity type of the epitaxial layer disposed over the voltage sustaining region to define a junction therebetween.

(See Figs. 4d and 16).

Product by process limitation:

The expression “said doped column being formed from at least one annular doped region and another doped region diffused into one another” is/are taken to be a product by process limitation and is given no patentable weight. A product by process claim directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

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**Note that Applicant has burden of proof in such cases** as the above case law makes clear.

With respect to claim 31, the plurality of portions of the terraced trench (17) of Deboy includes a smallest width portion and a largest width portion, the smallest width portion being located at a depth in the epitaxial layer (4) such that it is closer to the substrate (1) than the largest width portion. (See Fig. 4d).

With respect to claim 32, the plurality of portions of the terraced trench (17) of Deboy are coaxially located with respect to one another. (See Fig. 4d).

With respect to claims 33 and 34, the plurality of portions of the terraced trench (17) of Deboy includes at least three portions that differ in width from one another to define at least two annular ledges and the at least one annular doped region includes at least two annular doped regions. (continuously doped).

Note that, the terraced trench of Deboy can be formed as discussed in claim 28 above.

With respect to claim 35, the epitaxial layer (4) of Deboy has a given thickness and further comprising the step of etching a first portion of the terraced trench by an amount substantially equal to  $1/(x+1)$  of said given thickness, where  $x$  is equal to or greater than a prescribed number of annular doped regions to be formed in the voltage sustaining region.

Since the terrace trench of Deboy is formed to have multiple steps, the limitation of the claim is met.



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Product by process limitation:

The expression “the step of etching a first portion of the terraced trench by an amount substantially equal to  $1/(x+1)$  of said given thickness , where x is equal to or greater than a prescribed number of annular doped regions to be formed in the voltage sustaining region.” is/are taken to be a product by process limitation and is given no patentable weight. A product by process claim directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

Note that Applicant has burden of proof in such cases as the above case law makes clear.

With respect to claim 39, the dopant of Deboy is boron.

With respect to claim 40, the surface area of the at least two annular ledges of Deboy are substantially equal to one another.

With respect to claim 41, the at least one active region (6) of Deboy further includes:

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a gate dielectric and a gate conductor (8) disposed above the gate dielectric;

first and second body regions (6) located in the epitaxial layer (4) to define a drift region therebetween, the body regions (6) having a second conductivity type (p); and

first and second source regions (7) of the first conductivity type (n) located in the first and second body regions (6), respectively.

With respect to claim 42, the body regions (6) of Deboy include deep body regions.

With respect to claim 43, the terraced trench (17) of Deboy has a circular cross-section.

***Claim Rejections - 35 USC § 103.***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 36 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Deboy '459 as applied to claim 30 above, and further in view of Kocon (U.S. Patent No. 6,376,878) of record.

With respect to claim 36, Deboy teaches a power semiconductor device having terraced trench.

Thus, Deboy is shown to teach all the features of the claim with the exception of the material filling the trench is a dielectric material.

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However, Kocon teaches: the trench (152) of a voltage sustaining region (432) of a power semiconductor device can be filled using a dielectric material (430).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to fill the trench of Deboy utilizing dielectric material as taught by Kocon because the dielectric material is thermally compatible with the device substrate.

With respect to claim 37, the dielectric material of Kocon is silicon dioxide.

7. Claim 44 is rejected under 35 U.S.C. 103(a) as being unpatentable over Deboy '459 as applied to claim 30 above, and further in view of Chen (U.S. Patent No. 5,216,275) of record.

Deboy teaches a power semiconductor device having at least one terraced trench.

Thus, Deboy is shown to teach all the features of the claim with the exception of the shape of terraced trench being square, rectangle, octagon, and a hexagon.

However, Chen teaches the voltage sustaining region of a power semiconductor device can have a cross-section shape selected from the group consisting of a square, rectangle and a hexagon. (See Figs. 3).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the trench of Deboy to have a cross-section shape selected from the group as taught by Chen because the performance of either shape remain almost unchanged.

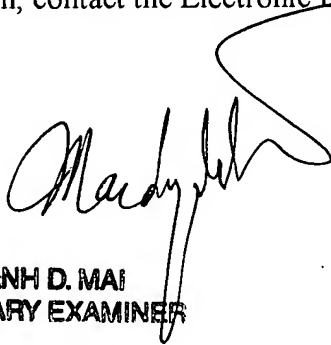
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*Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 9:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



**ANH D. MAI**  
**PRIMARY EXAMINER**

April 2, 2005